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HIGH-ALTITUDE COOLING

III - RADIATORS

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WASHINGTON

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ADVANCE RESTRICTED REPORT

HIGH-ALTITUDE COOLING

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SUMMARY

A detailed analysis has been made to take account of the high cooling-air velocity occurring in high-altitude radiators. Methods are developed for determining the heat-transfer rate, the pressure drop, and the drag power. Some effects of Mach number are shown. Radiator performance charts based on the analysis are presented for a wide range of the design variables. The application of the charts is shown by an example.

The performance charts show that the heat-transfer rate for a given total-pressure loss is not greatly affected by the high airplane velocities but that the necessary total-pressure loss and the resulting drag are both greatly increased at high altitudes.

INTRODUCTION

Extensive literature is available relative to the performance of ethylene-glycol radiators in the normal range of operating conditions. At high altitudes, however, certain effects that normally receive but little consideration acquire increased importance as a result of the high velocities of the cooling air through the tubes. The purpose of this paper is to describe and evaluate these effects.

The theories are outlined on which are based the calculations of heat transfer, of friction pressure drop, and of acceleration pressure drop at high Mach numbers. A general differential equation for the pressure drop and some approximate solutions for the equation are given. Radiator design charts based on the simplest of these approximate solutions are included. These charts